PATENT ABSTRACTS OF JAPAN

(11)Publication number : **09-254006**
(43)Date of publication of application : **30.09.1997**

(51)Int.CI. B24B 27/06

(21)Application number : **08-094854**
(22)Date of filing : **25.03.1996**

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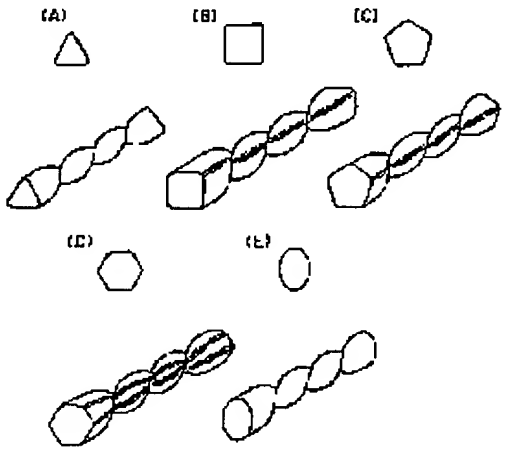
(54) WIRE FOR WIRE SAW

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance cutting ability of a wire saw, by securely supplying an abrasive particle to a contact part between a wire and a cut workpiece.
SOLUTION: This wire for a wire saw is as follows. 1) A wire for a wire saw is formed by an element wire of polygonal or elliptic sectional shape. 2) The wire is formed by a single element wire of polygonal or elliptic sectional shape, this element wire is placed in a twisted condition. 3) The wire is formed by two or more element wires, a sectional shape of at least one of these element wires is a polygon or an ellipse. 4) The wire is formed by two or more element wires, these element wires are placed in a twisted condition, a sectional shape of at least one of the element wires is set to a polygon or an ellipse. 5) The wire is formed by an element wire of carbon fiber.



LEGAL STATUS

[Date of request for examination] 11.11.2002

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the wire used for the wire saw used for cutting of a precision industrial material.
[0002]
[Description of the Prior Art] As equipment which starts the plate-like material of fixed thickness from cut objects (work), such as an ingot of compound semiconductors, such as a quartz or a semiconductor silicon ingot, and GaP, InP The slicing machine which cuts a cut object with the rotating diamond edge, or -- many, while making the cutting edge which finished setting up the steel plate of the shape of sheet metal of several sheets in parallel through the spacer move reciprocately Besides the band saw which cuts a cut object by supplying an abrasive grain to the contact portion of a cutting edge and a cut object While twist around many slots in which the wire which consists of steel wire, such as piano wire of one narrow, was prepared by two or more rollers, making it run, running ** a wire or making it move reciprocately on the other hand and carrying out the pressure welding of the cut object to this The wire saw which cuts a cut object is used for the contact portion of a wire and a cut object by supplying an abrasive grain.
[0003] Since the wire of a small path can be used in the wire saw mentioned to this last compared with the thickness of the diamond edge used by the slicing machine, and the steel plate used by the band saw an expensive material can be cut by small OFF cost -- and -- many -- the plate-like material of several sheets can be started simultaneously -- Furthermore, it has advantages, like various cut objects can be cut with a very sufficient precision, and the ingot of compound semiconductors, such as a quartz or a semiconductor silicon ingot, and GaP, InP, etc. can be cut with high productive efficiency.
[0004]
[Problem(s) to be Solved by the Invention] In order to aim at the high integration and its improvement in productivity in a semiconductor device in recent years, the quartz ingot used as the semiconductor silicon ingot used as the material or a substrate for masks is enlarged. However, in case such a large-sized cut object is especially cut by the wire saw, the abrasive grain was hard to be supplied to the contact portion of a wire and a cut object, and the problem that a cutting speed cannot be enlarged has arisen.
[0005] Therefore, even if it is the case where a large-sized cut object is cut, to heighten the cutting capacity of a wire saw, as an abrasive grain is certainly supplied to the contact portion of a wire and a cut object is wished so that it can cut by the large cutting speed.
[0006]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, as a result of repeating research variously, when the wire which a cross-section configuration becomes from the strand of polygon or ellipse type was used in the state where it was twisted preferably, in the wire saw, this invention persons could supply the abrasive grain to the contact portion of a wire and a cut object certainly, and found out that the cutting capacity of a wire saw could be heightened. Furthermore, when consisting of a strand of two or more carbon fibers especially, the wire which consists of a strand of a carbon fiber could also supply the abrasive grain to the contact portion of a wire and a cut object certainly, and that the cutting capacity of a wire saw can be heightened also found it out.
[0007] Therefore, this invention is characterized by the bird clapper from the strand whose cross-section configuration over one medial axis is a polygon or an ellipse form. The cross-section configuration over the wire for wire saws and two medial axes consists of one strand which is a polygon or an ellipse form. The wire for wire saws characterized by this strand being in the state where it was twisted, 3) It consists of two or more strands, and is characterized by at least one of these strands being the strand whose cross-section configuration over a medial axis is a polygon or an ellipse form. It consists of a wire for wire saws, and a 42 more than strand, and these strands are in the state where it was twisted. At least one of a strand makes a summary the wire for wire saws characterized by being the strand whose cross-section configuration over a medial axis is a polygon or an ellipse form, and the wire for wire saws which it becomes from the strand of five carbon fiber.
[0008] If such a wire is used, since it becomes that an abrasive grain is held at a wire, and it is easy, and is easy to be discharged, a certainly new abrasive grain can be supplied to the contact portion of a wire and a cut object by run of a wire, consequently the cutting capacity of a wire saw can be heightened.
[0009]

[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained. The wire for wire saws of this invention of the above 1 consists of a strand whose cross-section configuration over a medial axis is a polygon, for example, a triangle, a square, a pentagon, a hexagon, or an ellipse form. The wire for wire saws of this invention of the above 2 twists the above strands, and is produced. Thus, by twisting, an abrasive grain becomes that it is easier to be held, and can raise the cutting capacity of a wire saw to a wire more. Drawing which expresses a cross-section configuration for some examples of the wire for wire saws of this invention of the above 2 to drawing 1 , and a partial perspective diagram show.

[0010] The wire for wire saws of this invention of the above 3 consists of two or more strands, and the cross-section preferably as opposed to / at least one / a medial axis in more than the half of a strand] configuration of a strand is the strand which is a polygon, for example, a triangle, a square, a pentagon, a hexagon, or an ellipse form. Thus, if the cross-section configuration over a medial axis uses the strand which is a polygon or an ellipse form, rather than the case where only a circular strand is used, an abrasive grain is easier to be held at a wire, and it becomes that it is easier to be discharged, and the cutting capacity of a wire saw can be heightened more. The wire for wire saws of this invention of the above 4 twists such two or more strands, and is produced. Thus, by twisting, an abrasive grain becomes that it is easier to be held, and can raise the cutting capacity of a wire saw to a wire more. In the wire of the above 4, the strand whose cross-section configuration is a polygon or an ellipse form is twisted, and the strand currently twisted may be twisted with other strands.

[0011] Furthermore, in the wire for wire saws of this invention of the above 3 and 4, since an abrasive grain becomes a wire that it is easier to be held so that there are many numbers of a strand, it is desirable to make [more] the number of a strand. However, in order to make OFF cost small so that the number of a strand is made [many], it is desirable to also change the path of the abrasive grain which makes the wire size of a strand small and is used in the case of cutting. Drawing which expresses a cross-section configuration for some examples of the wire for wire saws of this invention of the above 4 to drawing 2 , and a partial perspective diagram show.

[0012] Although any will be sufficient, for example, metals, such as steel and a tungsten, or the polymeric materials of high tension will be mentioned if usually used as a material of a strand, it excels in abrasion resistance and, as for the material of the above-mentioned strand, it is desirable that it is steel from the point of being cheap. Furthermore, a carbon fiber can also be used as a strand. Intensity of a carbon fiber is comparatively high, and when a part for this soma of the case where a wire should be disconnected, and wire saws, such as a roller, has been cut by unlike polymeric materials passing current since it is conductivity, it can detect and is because the emergency stop of a wire saw is possible. It is desirable to use a carbon fiber as a strand in the wire of the above 3 and 4 especially to make OFF cost small by the case where many strands of a book are used. It is because it has comparatively high intensity, an open circuit cannot take place easily and a carbon fiber of a wire size (10 micrometers) which becomes the same size as the size (200 micrometers) of the usual piano wire can also make a wire size small comparatively easily, when 400-500 are bundled, although the intensity of a strand falls and it becomes the cause of an open circuit, when the wire size of a strand is made small, in order to carry out OFF cost to the material of a strand being steel here small.

[0013] The wire for wire saws of this invention of the above 5 consists of a strand of a carbon fiber. Especially in the wire which consists of a strand of such a carbon fiber, when consisting of a strand of two or more carbon fibers, an abrasive grain is held, and it is easy, and is easy to be discharged, and the cutting capacity of a wire saw can be heightened. In this case, even if the cross-section configuration of the strand of a carbon fiber is circular, it may be a polygon or an ellipse form. When consisting of a strand of two or more carbon fibers, a strand may be in the twisted state or the knit state.

[0014] Each wire for wire saws of this invention can be used for all of the general wire saw used now as it is. An example of the general wire saw used now is shown in drawing 3 . It is equipment which can cut down a wafer from the silicon ingot manufactured by the single crystal Czochralski method, and the wire saw shown in drawing 3 has extended towards the wire reception section B, after one wire 1 which extends from the wire send section A is spirally twisted around the circumference of three rollers 2, 3, and 4 in a predetermined pitch. Moreover, the downward roller 2 is a drive roller and it can be made to run a wire 1 with a necessary linear velocity. Moreover, two upper rollers 3 and 4 are arranged in the same height, and between this roller 3 and 4 is the processing section 5. The work holder 6 for holding Work W and the nozzles 7 and 7 which supply an abrasive-grain slurry (thing which made the detailed abrasive grain suspend in an oily or water-soluble coolant) towards the processing section 5 are arranged above the processing section 5. By rise-and-fall means by which it does not illustrate, the aforementioned work holder 6 can be moved up and down and can carry out the pressure welding of the work W to a wire 1. Under the processing section 5, the slurry receptacle 8 for receiving an abrasive-grain slurry is arranged.

[0015] As a workpiece which can be cut with the wire for wire saws of this invention, the ingot of advanced high-performance material, such as a quartz, a semiconductor material, an oxide crystal and ceramics, and a magnetic material, and a block are mentioned, for example.

[0016]

[Example] With the square, the cross-section configuration twisted one steel wire the piece of whose is 250 micrometers, and the wire (this invention wire 1) whose outer diameter is about 300 micrometers was produced. Moreover, the cross-section configuration twisted with the square three steel wire the piece of whose is 120 micrometers, and the wire (this invention wire 2) whose outer diameter is about 300 micrometers was produced. Furthermore, the cross-section configuration twisted 1080 carbon fibers whose outer diameters are 10 micrometers by the hexagon, and produced the wire (this invention wire 3) whose outer diameter is about 300 micrometers. Moreover, the wire (the conventional wire) which an outer diameter becomes from one piano wire (steel wire with a circular cross-section configuration) which is 300 micrometers for comparison was also

prepared.
[0017] The large-sized quartz (a 200mmx200mm angle, a length of 300mm) was cut by the wire saw using these four wires. As an abrasive grain, GC#600 (20 micrometers of mean particle diameters) was used. During cutting, while the abrasive grain observed whether the contact portion of a wire and a work would be supplied certainly, it asked for the average cutting speed. These results are shown in Table 1 with cutting capacity. Cutting capacity is the value which measured the average cutting speed at the time of using this invention wires 1-3, having used the average cutting speed at the time of using a comparison wire as 100%.
[0018]
[Table 1]
table 1 [ ] supply state [ ] -- a part [ ] for about 250-micrometer/-- 100% [0019] Average cutting speed Cutting capacity This invention wire 1 Certain A part for about 450-micrometer/ 180% This invention wire 2 Very certain A part for about 550-micrometer/ 220% This invention wire 3 Very certain A part for about 400-micrometer/ 160% The conventional wire Uncertain If this invention wires 1-3 are used so that clearly from Table 1, using the conventional wire, an abrasive grain will be certainly supplied to the contact portion of a wire and a work, and the cutting capacity of a wire saw will increase [rather than].
[0020]
[Effect of the Invention] According to this invention, even if it is the case where a large-sized cut object is cut, an abrasive grain is certainly supplied to the contact portion of a wire and a cut object, consequently can heighten the cutting capacity of a wire saw.

[Translation done.]